in claims 2 and 3. Both claims have been rewritten in independent form, including all of the limitations of independent claim 1.

Claim Rejections

Claims 1, 24, and 29 have been amended for clarification purposes only, to clarify that when the stator windings of one phase are excited with a direct current, m pieces of N pole and m pieces of S pole are formed alternately on those pieces of stator main pole that correspond to the excited phase. For the reasons set forth below, Applicants respectfully assert that all of the claims are directed to allowable subject matter and that the application is in condition for allowance.

The Examiner rejects, under 35 USC § 103, claims 1 and 20 - 29 over Sakamoto (U.S. Patent No. 5,386,161) in view of Bedford (U.S. Patent No. 3,678,352).

These rejections are respectfully traversed.

The Examiner admits that Sakamoto does not disclose m pieces of N pole and m pieces of S poles formed alternately on the 6m pieces of stator main pole, but alleges that the invention of claim 1 would have been obvious in light of Bedford.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the reference or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references, when combined, must teach or suggest all of the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure (MPEP

2142). The prior art must suggest the desirability of the claimed invention (MPEP 2143.01).

Applicant asserts that the Examiner has not cited proper motivation to combine Sakamoto with Bedford. Furthermore, Applicant asserts that the combination of Sakamoto and Bedford would teach away from the claimed invention because the Examiner's proposed modification would render the Sakamoto device inoperable.

Sakamoto discloses a hybrid stepping motor including a permanent magnet wherein three phase stator windings are arranged such that when the stator windings of one phase are excited with a direct current, the stator pole pieces corresponding to the excited phase have the same magnetic pole type. For example, referring to Figure 3 of Sakamoto, when the first phase stator windings are excited, stator poles 1-1 and 1-4 both form N poles.

In contrast, in the present invention of independent claims 1, 24 and 29, when the stator windings of one phase are excited with a direct current, alternating N and S poles are formed on the stator poles corresponding to the excited phase. For example, referring to Figure 1, when stator windings 21-1 and 21-4 are energized, pole 22-1 forms a S pole, while pole 22-4 forms a N pole.

Bedford discloses brushless permanent magnet motors. In one embodiment, the Bedford motor uses three pairs of opposing 60° stator windings (see column 9, lines 5 - 12; Figure 4a). In the embodiment disclosed in Figure 4a, opposing stator windings operate to form opposing N and S poles when excited. In Bedford, the excitation of one phase of the stator windings is accomplished with the stepped waveforms illustrated in Fig. 4b of Bedford. Bedford at column 3, lines 10-15 states: "Figs. 4b and 4c show respectively the quasi-square voltage wave shapes supplied to three adjacent stator windings of the Fig. 4a motor by the motor control circuit of Fig. 2b when modified to have delta-connected pairs of stator windings as illustrated in Fig. 4c."

Further, the brushless motor of Bedford requires a sensor for sensing the position of the rotor and a feedback circuit for the sensor output.

The Examiner states that the presently claimed invention is unpatentable over Sakamoto in view of Bedford because "it would have been obvious to utilize the winding arrangement of Bedford in the circuit of Sakamoto in order to increase efficiency" (see page 2, paragraph 3 of the Office Action).

Applicant asserts that there is absolutely no motivation to utilize the winding arrangement of the brushless motor illustrated in Bedford in the hybrid motor of Sakamoto. The winding arrangement of the brushless motor illustrated in Bedford only produces the alternating N and S poles when excited by the stepped waveforms illustrated in Fig. 4b of Bedford. The winding arrangement of the brushless motor illustrated in Bedford is useless without the corresponding control circuit of Bedford, and the corresponding control circuit of Bedford is unnecessary in the open loop operation of the motor of Sakamoto.

Moreover, use of the Bedford winding arrangement by itself in the hybrid motor of Sakamoto would render the device inoperable. In Sakamoto, when stator windings on poles 1-1 and 1-4 are energized, each pole becomes an N pole, and each applies a torque to the rotor. Upon examination of Figure 3 of Sakamoto, it is apparent that each stator pole 1-1 and 1-4 applies an equal torque to the rotor, and that the separate torque forces are applied in a cumulative rotary direction.

If the winding arrangement of the Bedford motor were utilized in the Sakamoto motor, when the windings corresponding to stator poles 1-1 and 1-4 are excited with a direct current, one stator pole would become N, and the other would become S. In this case, stator poles 1-1 and 1-4 would exert equal but opposite torque forces on the rotor. The total torque would

amount to zero. Thus, if the winding arrangement of Bedford were utilized in the Sakamoto motor, the Sakamoto motor would be rendered inoperative.

If a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification (MPEP § 2143.01, citing *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)).

Therefore, Applicants respectfully submit that Sakamoto in view of Bedford does not render independent claims 1, 24 and 29 obvious.

The Examiner also rejects, under 35 USC § 103, claims 1 and 24 as being anticipated by Bedford in view of Ray (U.S. Patent No. 5,804,941). The Examiner states that it would have been obvious at the time the invention was made for one of ordinary skill in the art to have utilized the control system of Ray with the motor of Bedford in order to use the Bedford device for controlling various machines.

As discussed above with respect to Bedford, Bedford discloses brushless motors having stator windings that are excited using a control circuit, a feedback loop, and the stepped waveforms illustrated in Figs. 4b. Further, the Bedford motor does not include all the limitations recited in claims 1 and 24 because the Bedford motor does not include a rotor including a cylindrical permanent magnet magnetized in the circumferential direction. The Bedford rotor instead is of the convex pole type, and generates a cogging torque.

The motor of Ray does not cure the deficiencies of the motor of Bedford. In particular, the motor described in Ray is a switched reluctance stepping motor also having a rotor of convex pole type, as seen in Fig.1 of Ray. This rotor is not a permanent magnet at all, and is certainly

not a cylindrical permanent magnet.

Thus, the combination of Ray and Bedford does not teach or suggest all of the limitations recited in claims 1 and 24.

The Examiner also rejects, under 35 USC § 103(a), claims 29 as being unpatentable over Bedford as modified by Ray and further in view of Mecrow (U.S. Patent No. 5,545,938).

This rejection is respectfully traversed, for the reasons noted above with respect to Bedford and Ray. Mecrow also does not cure the deficiencies of Bedford and Ray, because the motor of Mecrow is also a switched reluctance motor. The rotor is not of the permanent magnet type.

Therefore, Applicants respectfully submit that independent claims 1, 24 and 29 define patentable subject matter. Claims 20-23 depend from independent claim 1, and claims 25-28 depend from independent claim 24 and therefore also define patentable subject matter. Accordingly, Applicants respectfully request the withdrawal of the rejections under 35 USC § 103.

CONCLUSION

Based on at least the foregoing amendments and remarks, Applicants respectfully submit this application is in condition for allowance. Favorable consideration and prompt allowance of claims 1-3 and 20-29 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in better condition for allowance, the Examiner is invited to contact Applicants' undersigned representative at the telephone number listed below.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

The Commissioner is hereby authorized to deduct any additional fees arising as a result of this Amendment or any other communication from or to credit any overpayments to Deposit Account No. 50-2522.

Respectfully submitted,

Julie Zavoral

Julie A. Zavoral
Attorney for Applicant
Reg. No. 43,304

Dated: 26 December 2002

Patterson, Thuente, Skaar & Christensen, LLC
2000 U.S. Bank Center
777 East Wisconsin Avenue
Milwaukee, Wisconsin 53202
Telephone: (414) 276-0977
Facsimile: (414) 276-0982

Version with markings to show changes made

Wherein deleted material is **[bracketed]** and additions are **underlined** as follows:

1. (Twice Amended) A magnet type stepping motor comprising

(1) a stator having three-phase stator windings, and 6m pieces of stator main pole arranged side by side, where m is an integer and ≥ 1, the stator windings of one phase being wound around a first stator main pole and every third stator main pole among the 6m pieces of the stator main pole, wherein when the stator windings of one phase are excited with a direct current, m pieces of N pole and m pieces of S pole are formed alternately on **[the 6m]** **those** pieces of stator main pole **that correspond to the excited stator windings**, and

(2) a rotor of a cylindrical permanent magnet magnetized in the circumferential direction so as to form Z/2 pieces of N pole and Z/2 pieces of S pole alternately, where Z is the number of rotor poles.

2. (Amended) **[The permanent magnet type stepping motor as claimed in claim 1,]** **A magnet type stepping motor comprising:**

(1) a stator having three-phase stator windings, and 6m pieces of stator main pole arranged side by side, where m is an integer and ≥ 1, the stator windings of one phase being wound around a first stator main pole and every third stator main pole among the 6m pieces of the stator main pole, wherein when the stator windings of one phase are excited with a direct current, m pieces of N pole and m pieces of S pole are formed alternately on those 6m pieces of stator main pole that correspond to the excited stator windings, and

(2) a rotor of a cylindrical permanent magnet magnetized in the circumferential direction so as to form Z/2 pieces of N pole and Z/2 pieces of S pole

alternately, where Z is the number of rotor poles, and wherein the number of rotor poles is set to m ·(12n± 2) **[preferably]**, where n is an integer and ≥ 1.

3. (Amended) **[The permanent magnet type stepping motor as claimed in claim 1,]** **A magnet type stepping motor comprising:**

(1) a stator having three-phase stator windings, and 6m pieces of stator main pole arranged side by side, where m is an integer and ≥ 1, the stator windings of one phase being wound around a first stator main pole and every third stator main pole among the 6m pieces of the stator main pole, wherein when the stator windings of one phase are excited with a direct current, m pieces of N pole and m pieces of S pole are formed alternately on those 6m pieces of stator main pole that correspond to the excited stator windings, and

(2) a rotor of a cylindrical permanent magnet magnetized in the circumferential direction so as to form Z/2 pieces of N pole and Z/2 pieces of S pole alternately, where Z is the number of rotor poles, and wherein the number of rotor poles is set to m ·(12n± 2) [preferably], and a plurality of pole teeth are formed on each of the stator main poles, where n is an integer and ≥ 2.

24. (Amended) A magnet type stepping motor comprising:

a stator having three-phase stator windings and 6m stator pole pieces, where m is an integer and ≥ 1, the stator windings of one phase being wound around a first stator pole piece and every third stator pole piece among the 6m the stator pole pieces, wherein when the stator windings of one phase are excited with a direct current, m pieces of N pole and m pieces of S pole are formed alternately on **[the 6m]** those stator pole pieces **that correspond to the excited stator windings**; and

a rotor of a cylindrical permanent magnet magnetized along the circumference so as to form a plurality of continuously alternating N and S rotor poles, wherein the number of N rotor poles equals the number of S rotor poles.

29. (Amended) A magnet type stepping motor comprising:

a stator having three-phase stator windings and twelve stator pole pieces, the stator windings of one phase being wound around a first stator pole piece and every third stator pole piece among the twelve the stator pole pieces, wherein when the stator windings of one phase are excited with a direct current, two pieces of N pole and two pieces of S pole are formed alternately on **[the twelve]** <u>those</u> stator pole pieces **<u>that correspond to the excited stator windings</u>**; and

a rotor of a cylindrical permanent magnet magnetized along the circumference so as to form alternating N and S rotor poles, wherein the number of N rotor poles equals the number of S rotor poles.